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FINAL REPORT

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FEEDING MANAGEMENT TO MAXIMIZE MILK PROTEIN PRODUCTION

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Feeding Management to Maximize Milk Protein Production

Final Report

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Final Report

A. Abstract

The objective of this project was to develop feeding and management strategies to maximize milk protein content of milk produced in Saskatchewan. In 1999 the pricing system for milk changed to a system of multiple component pricing in which milk protein fat and other solids together with the amount of milk were used to calculate the price per 100 kg. Protein is the highest value component of the milk and a strategy to minimize milk fat percentage and maximize milk protein percentage is usually economically desirable. In a dairy production trial in which amino acid levels were balanced only a very small effect on milk protein composition was found. Surveys of on farm factors that influence milk composition were conducted both in the Edmonton area and in the Saskatoon milk shed. A study was also conducted in cooperation with the Lethbridge Agriculture and Agri-Food Canada Station. The annual pattern of milk composition in Saskatchewan has remained the same for many years. Milk protein and fat percentage peak in October and November while milk yield tends to be highest in the spring and early summer. A number of factors were found that have a small but statistically significant effect on milk protein content. Rations containing a higher proportion of small feed particles (< 9 mm) were associated with a higher milk protein yield and also a higher milk yield. High barn temperatures were associated with a reduction in milk protein percentage. Herds that had a higher proportion of cows with a body condition score of 3.0 to 3.5 had a higher milk protein percentage and yield. This trial shows that it is not easy to greatly influence milk protein percentage and yield, however, maximizing milk yield while keeping cows in good body condition and meeting amino acid requirements together with maintaining good ventilation and barn temperature are factors to consider.

B. Executive Summary

The objective of this project was to develop feeding and management strategies to maximize the milk protein content of milk produced in Saskatchewan. The Saskatoon dairy processing plant now owned by Saputo Inc. emphasizes cheese production. The protein content of milk supplied to that plant is therefore important in maximizing cheese yield and it is also economically important to producers in that the price paid for milk is influenced by the protein content. Under the new multiple component pricing system quota is set by milk fat yield (kg/year) while the price per 100 kg of milk is determined by the fat, protein and other solids content. The value of protein is about $2.00/kg higher than the value of fat. There is considerable research from other studies that have shown beneficial effects of protein content and amino acid composition of the dairy ration. In an amino acid balance trial conducted with the University of Saskatchewan herd only a very small increase in milk protein percentage was achieved by including either blood meal or fish meal in the ration. This study was conducted with high yielding cows (40 kg average daily production for the 120 day trial) and milk protein yield may have been close to the genetic maximum for these cows. In a trial conducted at the Agriculture and Agri-Food Canada Research Station at Lethbridge protein yield and percentage was only very slightly influenced by forage concentrate ratio. In survey studies conducted both in the Edmonton and Saskatoon areas it was found that rations containing a higher proportion of smaller particles either forage or concentrate appeared to increase both milk and protein yields. In the Saskatoon survey it was found that cows in good body condition kept at a lower barn temperature or during periods of

lower temperature had higher protein yield and percentage. In this study it was also found that a higher proportion of small particles (< 9 mm) increased both milk yield and milk protein yield.

From these studies it is concluded that cows kept in good body condition that is slightly higher than currently recommended and rations with small feed particles tend to produce higher milk protein yield and percentage. Rations balanced for amino acids using the CPM dairy model maintain a high level of milk production and milk protein content without the inclusion of more expensive protein supplements such as fish meal or blood meal. There may be a small benefit to the inclusion of these products, however, rations can be balanced satisfactorily using readily available soybean meal, canola meal, and wheat distiller's grains.

C. Technical Report

The objective of this project was to develop feeding and management strategies to maximize milk protein content of milk produced in Saskatchewan. The reason for initiation of this project was based on the conversion of the milk payment system to a multiple component pricing system in which milk protein, milk fat, other solids, and milk volume were used as the basis for payment. Milk fat yield (kg/year) became the basis for a quota allocation based on the Canadian Dairy Commission Guidelines. The value of milk protein depends on the end use of the milk, but in general is about $2.00/kg higher than the value of fat in the Western Milk Pool. Therefore a strategy for dairy producers to maximize income would be to minimize milk fat percentage while maximizing milk protein percentage. The Saskatoon milk processing plant now owned by Saputo Inc. has been converted to the major cheese production plant for western Canada. With the Western Pool milk pricing system there is no specific advantage to Saskatchewan producers through the location of this plant, however, its conversion to high value cheese is of general value to western Canada and is of benefit to Saskatchewan producers when milk is processed for cheese due to the value of milk protein in this class of milk.

Progress Report #1 outlined the activities being undertaken in the project. These included a comprehensive survey of literature on factors affecting milk composition with emphasis on protein content and an analysis of the effect of milk yield and composition on individual farm revenue. The graduate student (Cerah Richardson) assigned to this project attended an international symposium on milk composition held in Belfast, Ireland, in September 1999.

In Progress Report #2 it was noted that the basic literature review had been completed and that a dairy production trial examining the effect of amino acid balance on milk protein percentage and yield was underway. The results of that trial are included in this final report. A survey conducted by Michelle Schroeder, a 4th year Animal Science student in the Edmonton area in cooperation with the University of Alberta, determined a number of factors influencing milk composition. In this survey the forage concentrate ratio and the proportion of smaller particle size material in the total mixed ration (less than 9 mm diameter) increased milk yield and milk protein yield. Marina Maekawa conducted a M.Sc. study in cooperation with the Lethbridge Agriculture and Agri-Food Canada Research Station on the effect of forage concentrate ratio and feeding system on milk composition. In the results of this trial reported in Progress Report #4, milk protein percentage was maintained at approximately 3.3% in all of the treatments. This probably represents the maximum average yield for Holstein cows at high levels of milk

production. The high energy density in these rations probably accounted for this result with the energy and nutrient balance being such that it maximized rumen microbial growth and hence amino acid requirements were met together with energy requirements.

In Progress Report #3 preliminary results were provided on the protein source and amino acid balance dairy production trial. Although the results were not statistically significant there was a trend for both blood meal and fish meal to increase milk protein percentage and also to increase milk casein yield. This increase was in relation to the control ration which was the standard University of Saskatchewan high production ration and also in relation to a ration based on a heated canola product. Progress Report #3 also contained information from a first farm survey conducted by Cerah Richardson as part of her M.Sc. program. This survey revealed considerable variation in feed intake and ration characteristics of the survey farms. Based on this information a second survey was conducted and is included in this final report.

Additional information is included in this final report derived mainly from Cerah Richardson's M.Sc. thesis. Extracts from this thesis are included in Appendix 1. In this Appendix, information obtained from the Milk Control Board and the Provincial Dairy Laboratory on milk composition for three years is summarized in Figures 3.3 and 3.4. Milk protein and milk fat percentage peaked in the months of October and November period. Milk yield, however, tended to be highest in the spring and early summer period. The annual pattern in milk composition was first observed in the 1930s. Although dairy cattle are for the most part housed indoors, the pattern appears to be associated with day length rather than with feeding program. Milk composition patterns in Australia and New Zealand follow the same seasonal pattern as in North America with peak protein and fat content during the late fall.

Milk production and composition on the 11 surveyed farms are included in Tables 4.1 through 4.8. Average milk production on similar farms with dairy herd improvement records averages just under 30 kg per cow daily. Therefore, the survey herds represented herds that were both above and below the average. Daily feed intake information was collected for a 60 day period in May and June. Milk protein content (Table 4.4) ranged from 3.10 to 3.36% on these farms. The protein yield ranged from a low of 0.88 kg to 1.12 kg of protein daily. An unexpected finding was the high number of average days in milk (209). The expected average days in milk is about 160. The average lactation number was 2.6 indicating that the average cow would be culled at less than five years of age. As shown in Table 4.12 dry matter intake was associated with an increase in milk protein percent. High daily barn temperature and high milk yield were associated with lower milk fat percentage. Milk yield was one of the major determinants of protein yield. When particle size distribution of the total mixed rations was examined (Table 4.15) it was found that a high proportion of small particles (< 9 mm) were associated with a lower milk fat percentage but a higher milk protein yield. The reason for this effect is that a higher proportion of small particle size was strongly associated with an increase in milk yield.

The nutrient content of the total mixed rations on the 11 farms were for the most part in the range expected for satisfactory milk production. Several exceptions, however, were noted in that farms 1, 3, 5, 6, and 9 contained less than 17% crude protein in the ration dry matter. This means that cows in these herds would not be expected to peak or hold their peak as well as cows fed rations containing more than 17% crude protein. The acid detergent fibre levels were for the most part

higher than recommended. NDF contents were in or slightly below the expected and recommended ranges. Non fibre carbohydrate content of the ration had a significant positive effect on milk protein percentage, while dry matter intake and high barn temperature were associated with reductions in milk protein percentage.

Body condition scores were for the most part in the expected range. Several farms (4 and 5) had more cows than was expected with body condition scores of 2.5 or lower. Most cows fell into the 3.0 to 3.5 body condition score range with some herds having as many as 30% of the cows with body condition scores of 4. Both milk protein percent and yield were positively correlated with body condition scores of 3.5 or greater. Cows with a body condition score or 3 or less resulted in a negative correlation for protein yield and percentage. There is therefore a benefit in protein production to maintain cows in good body condition during lactation.

Appendix 2 contains a literature survey of references included in Cerah Richardson's thesis on topics related to milk yield and milk composition.

D. Personnel

Neil Webb, Technician
Amanda Kroeker, M.Sc. Student
Marlene Fehr, Research Associate

E. Equipment

No equipment was purchased for $500 or more.

F. Project Photos

Not relevant to this project. Support for this project is acknowledge in Cerah Richardson's thesis and will also be acknowledged in extension publications or talks arising from this project.

I. Expense Statement

The statement of expenditures will be provided by the University of Saskatchewan.